**Quadratic Modeling in Sport**

The following rubrics will be used to assess the student’s portfolio:

**Criterion C: Communication**

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| **Achievement**  **Level** | **Level Descriptor** | **Task Specific Clarification** |
| **0** | The student does not reach a standard described by any of the descriptors given below. | |
| **1-2** | The student shows **basic** use of mathematical language **and/or** forms of mathematical representation. The lines of reasoning are **difficult to follow**. | * The student uses some appropriate notation and/or terminology. * The student attempts to provide explanations or uses some appropriate forms of representation. * The student attempts to use a calculator or computer in a manner that could enhance the development of the tasks. |
| **3-4** | The student shows **sufficient** use of mathematical language **and** forms of mathematical representation. The lines of reasoning are **clear** though not always **logical** or **complete**. The student moves between different forms of representation **with some success**. | * The student mostly uses appropriate notation and/or terminology for each or most tasks. * The student provides adequate explanations or arguments, and communicates those using appropriate forms of representation. * The student makes limited use of a calculator or computer in a manner that enhances the development of the tasks. |
| **5-6** | The student shows **good** use of mathematical language **and** forms of mathematical representation. The lines of reasoning are **concise**, **logical** and **complete**. The student moves **effectively** between different forms of representation. | * The student uses appropriate notation and terminology in a consistent manner and does so throughout the work. * The student provides complete, coherent explanations or arguments, and communicates those clearly using appropriate forms of representation. * The student makes full and resourceful use of a calculator or computer in a manner that significantly enhances the development of the tasks. |

**Criterion D: Reflection**

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| **Achievement**  **Level** | **Level Descriptor** | **Task Specific Clarification** |
| **0** | The student does not reach a standard described by any of the descriptors given below. | |
| **1-2** | The student **attempts** to explain whether his or her results make sense in the context of the problem. The student **attempts to describe** the importance of his or her findings in connection to real life. | * The student has attempted to interpret the reasonableness of the results of the models in the context of some tasks. * The student defines some variables, parameters or constraints of the tasks. |
| **3-4** | The student **correctly but briefly explains** whether his or her results make sense in the context of the problem and **describes** the importance of his or her findings in connection to real life. The student **attempts** to justify the degree of accuracy of his or her results where appropriate. | * The student defines variables, parameters and constraints of most tasks and attempts to create a model for each task. * The student has correctly interpreted the reasonableness of the results of the model in most or all contexts of each task, to the appropriate degree of accuracy. |
| **5-6** | The student **critically explains** whether his or her results make sense in the context of the problem and provides a **detailed explanation** of the importance of his or her findings in connection to real life. The student **justifies** the degree of accuracy of his or her results where appropriate. The student **suggests improvements** to the method when necessary. | * The student correctly analyses variables, parameters and constraints of each task to enable the formulation of accurate models. * The student has correctly and critically interpreted the reasonableness of their results of the models in the context of all of the tasks. * The student included possible limitations and modifications of their results, to the appropriate degree of accuracy. |

**Part A: Quadratic Modeling in Sport**

You have seen that quadratic functions can be written in different ways.



**1.** For each equation, explain what information you can obtain about the graph from the different letters (parameters).

**2. Modeling Problem 1: Tiger in Trouble**



You are to find a curve that can model a golf shot. The shot must satisfy the following criteria:

* The golfer plays the shot from a coordinate of (0, 0).
* The ball must clear a tree which is 30 metres away from the golfer and which is 20 metres high.
* The shot should be played such that the ball stays as low as possible but clears the tree.

Decide which form of the quadratic function is going to be most useful. To help you decide you should consider the following questions.

* Which information needs to be “fixed”?
* Which equation will enable you to fix this information?

Once you have decided which form of equation is most suitable you should fix the parameters you need and then find suitable values for the other parameters.

Draw a graph of your curve and show that it satisfies the given requirements.

**Use your model to answer the following question.**

The original shot was played from a distance of 125 metres from the hole. After playing the shot over the tree how far is the ball from the hole? **3. Modeling Problem: Six in Cricket**



You are to find a curve that can model a cricket shot. The shot must satisfy the following criteria:

* The batsman plays the shot from a coordinate of (0, 0)
* The ball must clear the boundary rope that is 75m away from the batsman.

Decide which form of the quadratic function is going to be most useful. To help you decide you should consider the following questions.

* Which information needs to be “fixed”?
* Which equation will enable you to fix this information?

Once you have decided which form of equation is most suitable you should fix the parameters you need and then find suitable values for the other parameters.

Find **three curves** that could be used to model the shot. Check that each curve fits the required criteria.

Decide which of the curves would be most appropriate and **give reasons** for your choice.

**Use your model to answer the following question.**

A fielder is able to jump to a height of 2.5 metres to catch a ball. How far inside the boundary rope should he stand if he is to catch a ball that follows your model?

**4. Modeling Problem: Basketball Free Throw**

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You are to find a curve that can model a free throw in basketball. The throw must satisfy the following criteria:

* The thrower stands 15ft away from the basket
* The thrower releases the ball from a height of 8ft
* The basket is 10ft above the ground.

Decide which form of the quadratic function is going to be most useful. To help you decide you should consider the following questions.

* Which information needs to be “fixed”?
* Which equation will enable you to fix this information?

Once you have decided which form of equation is most suitable you should fix the parameters you need and then find suitable values for the other parameters.

Find **three curves** that could be used to model the shot. Check that each curve fits the required criteria.

Decide which of the curves would be most appropriate and **give reasons** for your choice. Comment on any problems that the rejected models may encounter.

**Use your model to answer the following question.**

Suppose an opposing player is able to stand 5ft away from the player making the throw and is able to block shots up to a height of 10ft. Check if your model will allow the opposing player to block the shot. If the shot will be blocked find another model that will allow the player making the throw to score a successful basket.